Wallace, R.A. 1979. The ecology and evolution of animal behavior. Good Year Publ. Co., Santa Monica, California. 284 pp.

U.S.D.I. 1979a. Snake River Birds of Prey Special Research Report to the Secretary of the Interior. Bureau of Land Management, Boise District, Boise, Idaho. 142 pp.

U.S.D.I. 1979b. Snake River Birds of Prey Annual Research Report. Bureau of Land management, Boise District, Boise, Idaho. 60 pp.

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USE OF INTRODUCED PERCHES BY RAPTORS: EXPERIMENTAL RESULTS AND MANAGEMENT IMPLICATIONS

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Abstract - Fourteen dead trees and 9 man-made perches were placed in the Sachuest Point National Wildlife Refuge, Rhode Island between 1977 and 1979 for use by the open country raptor community that inhabits the area during fall and winter. On 120 days during fall and winter 1978-79 and 1979-1980 raptors were observed on the introduced perches 525 times. American Kestrels (*Falco sparverius*), Short-eared Owls (*Asio flammeus*) and Northern Harriers (*Circus cyaneus*) in that order were the most frequent users. In all, 10 raptor species used the dead trees and 4 species used man-made perches. Kestrels displayed a preference for trees over constructed perches in 1979-80, but not in 1978-79. Kestrels used the perches for hunting, resting and prey consumption, but other raptors used them mostly for resting. These results suggest that introduced perches could play an important role in raptor conservation efforts.

Elevated perches are a habitat requirement of most birds of prey for hunting, resting and feeding (Brown and Amadon 1968, Brown 1976). The importance of perches has been documented by several investigators who noted the activity of raptors when first seen (Schnell 1968, Craighead and Craighead 1969, Marion and Ryder 1975, Bildstein 1978). The Red-shouldered Hawk (*Buteo lineatus*), Red-tailed Hawk (*Buteo jamaicensis*), Rough-legged Hawk (*Buteo lagopus*), Golden Eagle (*Aquila chrysaetos*) and American Kestrel (*Falco sparverius*) were perched during 50% or more of the observations of 1 or more of these authors. The importance of perches as a hunting substrate has been shown most clearly for American Kestrels. Several authors (Sparrowe 1972, Collopy 1973, Cruz 1976, Bildstein 1978) have found that kestrel attacks on prey were initiated from a perch in 71% or more of the attempts, and that the attacks initiated from a perch were more successful than attacks initiated from flight.

The erection of man-made perches, especially utility-line towers, has served as a passive raptor management tool by opening up millions of acres of habitat to hunting from stationary perches (Olendorff et al. 1980). For example, in Colorado, Stahlecker (1978) documented a concentration of raptors in the area immediately surrounding a newly constructed transmission line. Such findings have led to the introduction of elevated perches in suitable hunting range where tall perches are lacking (Christensen 1972, Snow 1974, White 1974, Steenhof 1977, Stumpf 1977, Hall et al. 1981). Herein I report the use of 2 types of raptor perches introduced into the Sachuest Point National Wildlife Refuge on the Rhode Island coastline.

Study Area and Methods

Sachuest Point is an 86 ha peninsula extending into the Atlantic Ocean from the southeast corner of Aquidneck Island, Rhode Island. The vegetated interior of the point is bordred by a 5 km perimeter of rocky shoreline and cobble beaches. Shrub and herbaceous communities, which dominate the peninsula, are interrupted by a network of roads and scattered buildings abandoned by the U.S. Navy. Bayberry (*Myrica pensylvanica*) is the dominant shrub species. It reaches 3 m in height in the northern section of the point where it occurs in clumps (ca 100-300 m^2) which are interspersed with shorter, mixed stands of goldenrod (*Solidago tenuifolia*) and blackberry (*Rubus* sp.). In the southern part of the peninsula, bayberry from 0.5 to 1.5 m tall forms dense, isolated stands 0.5 to 3.0 ha in area which are surrounded by an herbaceous community. Grasses, especially Autumn Bent (*Agrostis perennans*) and Red Fescue (*Festuca rubra*), are common and occur either alone or beneath a forb layer dominated by goldenrod (*Solidago* spp.) and Black Knapweed (*Centauria nigra*). Shrubs provide the cover throughout 52% of the vegetated region of the study area

and herbs cover the remaining area. Elevated perches were absent or scarce within all habitats on the refuge prior to the initiation of this study.

Five dead trees (∓ height = 4.8 m, range = 3.7-8.5 m) with numerous horizontal branches were erected on the refuge in the summer of 1977, and 9 more (∓ height = 4.8 m, range = 3.6-6.1 m) in the summer of 1979. Two trees were erected within the tall shrub community and 5 within the shorter, bayberry stands. The remaining 7 were erected within herbaceous habitats. In the summer of 1978, 9 man-made perches were erected. Each man-made perch consisted of a 6-m board, 5 cm x 10 cm size, fitted with two 2.5 cm dia. dowels. The dowels were cut into 65 cm lengths and centered through holes in the boards so that 30 cm of perch space was available on either side. The dowels were placed on each structure at heights of 2.25 m and 4.5 m above ground. Length of board in excess of 4.5 m was buried. Two perches were placed within tall shrubs, 3 within short shrubs, and 4 within herbaceous communities.

Raptors were observed for 1 h periods on 88 d between 1 September 1978 and 12 March 1979, and on 32 d between 12 November 1979 and 29 January 1980, from the roof of a 6 m high abandoned building near the center of the refuge. Thirty-five visits were made at various times in the morning; 85 were made from 1500 to 1700 h. For each observation of a perched raptor a record was made of species, perched height, individual perch number, and purpose for which the perch was used whenever this was apparent.

Results

Five species of raptors were seen during the 2 years (Table 1). During both periods, the Northern Harrier (*Circus cyaneus*), American Kestrel, and Short-eared Owl (*Asio flammeus*) were dominant. Harriers and kestrels were present in varying numbers throughout both study periods. Four Short-eared Owls arrived in November of 1978 and 1 in December of 1979; each remained until the end of the study period each year. The Sharp-shinned Hawk (*Accipiter striatus*) and Merlin (*Falco columbarius*) occured only as migrants; they were seen on perches in September and October 1978. Raptors were more abundant during the 1978-79 period, averaging 3.7 individuals/hr observation (range = 0-31). An average of 2.6 individuals/hr (range = 0-6 were seen during the shorter, 1979-80 period.

During the 120 h of observation, I made 525 sightings (4.4 sightings/hr) of raptors using the introduced perches (Table 1). All species except Sharp-shinned Hawks used both perch types at least once; sharp-shins used only dead trees. In addition, the Cooper's Hawk (*Accipiter cooperii*), Red-tailed Hawk, Rough-legged Hawk, Peregrine Falcon (*Falco peregrinus*), and Snowy Owl (*Nyctea scandiaca*) were also sighted on the dead trees.

Chi-square (X^2) tests were conducted using each of the 3 dominant raptor species to determine whether the more natural, dead-tree perches were used more than might have been expected by chance. During 1978-79, there were no significant differences ($P = 0.05$) in the use of natural vs. constructed perches for any of the 3 species. In 1979-80, kestrels used dead trees significantly more than expected ($P < 0.001$) ($X^2 = 15.3$, $df = 1$).

Raptors nearly always perched as high as possible on a perch. On man-made perches, the higher of 2

Table 1. Raptor Perch-Use Statistics.

Species	Individuals/Day ∓	Individuals/Day range	Percent of Days Present	# Perches Used # Perch Observations* Dead Trees	# Perches Used # Perch Observations* Constructed
Sharp-shinned Hawk	0.2	0-10	7	1- 3	-
Northern Harrier	1.4	0- 5	68	6- 35	6- 32
American Kestrel	1.2	0-21	67	14-190	8-149
Merlin	-	0- 1	2	3- 7	1- 1
Short-eared Owl	1.5	0- 4	43	11- 47	8- 61
Total				282	243

*Based on 88 h of observation of 5 dead trees and 9 man-made perches in 1978-79 and 32 h of observation of 14 dead trees and 9 man-made perches in 1979-80.

Table 2. Reported Perch Introduction Experiments.

Source and State	# Perches	Target Species	Raptors Using Perches
Christenson 1972 Utah	3	All Raptors	Swainson's Hawk (*Buteo swainsoni*) Red-tailed Hawk American Kestrel Great Horned Owl (*Bubo virginianus*) Long-eared Owl (*Asio otus*)
White 1974 Utah	8	Golden Eagle	Golden Eagle
Snow 1974 Colorado	2	All Raptors	Red-tailed Hawk Ferruginous Hawk (*Buteo regalis*) Golden Eagle Northern Harrier
Harrison 1977 Michigan	50	Grassland Birds	American Kestrel Short-eared Owl
Steenhof 1977 South Dakota	4	Bald Eagle	Bald Eagle
Steenhof 1977 Oregon	1	Bald Eagle	Bald Eagle
Stumpf 1977 Arizona	12	Bald Eagle	Red-tailed Hawk Harris' Hawk (*Parabuteo inicinctus*)
Hall et al. 1981 California	36	All Raptors	White-tailed Kite (*Elanus leucurus*) Red-tailed Hawk Northern Harrier American Kestrel Common Barn-Owl (*Tyto alba*) Short-eared Owl Great Horned Owl Burrowing Owl (*Athene cunicularia*)
This study Rhode Island	23	All Raptors	Northern Harrier Sharp-shinned Hawk* Cooper's Hawk* Red-tailed Hawk* Rough-legged Hawk* American Kestrel Merlin Peregrine Falcon* Snowy Owl* Short-eared Owl

*Used dead trees only.

available perches was selected in 97% of 32 harrier observations, 99% of 149 kestrel observations, and 85% of 61 Short-eared Owl observations. Except when eating prey, raptors perched within the uppermost branches.

I did not see harriers or owls attack prey from, or consume prey on, an introduced perch. These 2 species apparently used the introduced perches as resting sites between hunting forays. I witnessed 16 prey attacks by kestrels, 14 from man-made perches and 2 from dead trees. Six of the attacks from man-made perches and both from trees were successful. Kestrels were observed eating prey on trees and on man-made perches 10 times each. Kestrels

perched more frequently per individual/hr than Short-eared Owls, and owls perched more frequently than harriers.

DISCUSSION

A total of 20 raptor species, representing 2 orders and 4 families, have used perches introduced specifically for their use (Table 2). Although these numbers are impressive, not all attempts at raptor management by perch introduction have been successful. Perches introduced as part of Bald Eagle (*Haliaeetus leucocephalus*) management programs by the U.S. Bureau of Land Management (BLM) (Steenhof 1977) and the U.S. Bureau of Reclamation (Stumpf 1977) were little used by the target species. The BLM had better success with perches introduced for Golden Eagle management; numerous eagles were seen on the perches during the first year after their placement (White 1974). Snow (1974) reports that 4 raptor species used perches placed in a Colorado grassland community, and perches erected in agricultural fields by Hall et al. (1981) received extensive use by 8 species (Table 2).

To determine if introduced perches would serve as a means for enhancing biological control of undesirable rodents, Christensen (1972) placed 3 perches in areas of high pocket gopher (*Thomomys talpoides*) density. Five species of raptors used them (Table 2), and results strongly suggest that gopher numbers were reduced in the area immediately surrounding the perches. Over a broad area, however, the results were inconclusive.

At Sachuest Point I made an average of 1 sighting of a raptor on an introduced perch during each 14 min of observation. The use of the perches by hunting kestrels demonstrates a shift in their hunting strategy as a result of perch introduction, since prior to perch placement aerial hunting was the only method available. Furthermore, the hunting efficiency of kestrels may have improved following perch introduction since several authors have shown that kestrels prefer hunting from a perch rather than hover hunting, and were more successful when hunting from a perch than when hunting aerially in general (Sparrowe 1972, Collopy 1973, Cruz 1976, Bildstein 1978). The perches were also used extensively by kestrels for eating prey.

Despite the substantial documentation of introduced perch, no study has demonstrated an increase in raptor density within managed areas. Stahlecker (1978), however, censused wintering raptors before and after construction of a transmission line. His results demonstrate that raptor density in the area within 0.4 km of the transmission line (57 km^2) became greater than the density in the area beyond 0.4 km (98 km^2) as a result of the extensive use of transmission line towers as perches. The increased density within his study area following transmission line construction suggests a lack of perches was limiting raptor use of his study area.

In areas where the scarcity or absence of perches limits raptor numbers, perch introduction could play an important role in raptor management, at least where an increase in density is the goal. Unfortunately, perch requirements of raptors are not well understood, and it is not always evident if a particular raptor population or community would benefit from increased available perches. In areas where habitat destruction threatens raptor populations, it becomes increasingly important to create potential for increased densities in unaffected range. Managers of protected areas (national parks, public and private wildlife preserves, etc.) should assess perch availability and consider supplementation where a scarcity of perches may limit raptor numbers. Such efforts could help maintain stable raptor populations, especially wintering populations, in threatened areas.

Dead trees erected at Sachuest Point were readily accepted by all raptor species and were preferred by some over man-made perches. Dead trees are preferred perches of Bald Eagles (Steenhof 1977, Stumpf 1977) and were listed as one of the preferred perch types of buteos by Errington and Breckenridge (1938). Thus, trees should be considered for use in perch introduction projects where a source is available.

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LITERATURE CITED

BILDSTEIN, K.L. 1978. Behavioral ecology of Red-tailed Hawks (*Buteo jamaicensis*), Rough-legged Hawks (*B. lagopus*), American Kestrels (*Falco sparverius*) and other raptorial birds wintering in south-central Ohio. The Ohio State University. 364 p. Dissertation.

BROWN, L. 1976. Birds of prey: their biologyand ecology. New York: Hamlyn Publishing Group Limited. 256 p.

Brown, L. and D. Amadon. 1968. Eagles, hawks and falcons of the world. New York: McGraw-Hill Book Co. 945 p.

Christensen, R.C. 1972. Raptor predation on pocket gopher populations by the use of hunting perches. M.S. Thesis. Brigham Young University, Provo, Utah. 87 pp.

Collopy, M.W. 1973. Predatory efficiency of American Kestrels wintering in northwestern California, *Raptor Res.* 7:25-31.

Craighead, J.J. and F.C. Craighead, Jr. 1969. wks, owls and wildlife. New York Dover Publications. 443 p.

Cruz, A. 1976. Food and foraging ecology of the American Kestrel in Jamaica. *Condor* 78:409-423.

Errington, P.L. and W.J. Breckenridge. 1938. Food habits of *Buteo* hawks in northcentral United States. *Wilson Bull.* 50:113-121.

Hall, T.R., W.E. Howard, and R.E. Marsh. 1981. Raptor use of artificial perches. *Wildl. Soc. Bull.* 9:296-298.

Harrison, K.G. 1977. Perch height selection of grassland birds. *Wilson Bull.* 89:486-487.

Marion, W.R. and R.A. Ryder. 1975. Perch-site preferences of four diurnal raptors in northeastern Colorado. *Condor* 77:350-352.

Olendorff, R.R., R.S. Motroni, and M.W. Call. 1980. Raptor management — the state of the art in 1980. Pages 468-523 *in* R.M. DeGraff and N.G. Tilgham, eds., Management of western forests and grasslands for nongame birds. U.S.D.A. For. Serv. Gen. Tech. Rep. INT-86, 535 p. Intermt. For and Range Expt. Stn. Ogden, Utah 84401.

Schnell, G.D. 1968. Differential habitat utilization by wintering Rough-legged and Red-tailed hawks. *Condor* 70:373-377.

Snow, C. 1974. Ferruginous Hawk (*Buteo regalis*). U.S. Bur. Land Mgmt. Tech. Rep. No. T/N 255. Denver, Colorado. 23 p.

Sparrowe, R.D. 1972. Prey-catching behavior in the sparrow hawk. *J. Wildl. Mgmt.* 36:297-308.

Stahlecker, D.W. 1978. Effect of a new transmission line on wintering prairie raptors. *Condor* 80:444-446.

Steenhof, K. 1978. Management of wintering bald eagles. U.S. Fish and Wildl. Serv. FWS/OBS-78/79. 59 p.

Stumpf, A. 1977. An experiment with artificial raptor hunting perches. *Bird Watch* 5:1-2.

White, C.M. 1974. Current problems and techniques in raptor management and conservation. Trans. N. Am. Wildl. Conf. 39:301-311.

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